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Outcomes of vaginal breech delivery for singleton term pregnancies in a carefully selected Cameroonian population: a cohort study

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Title:

Outcomes of vaginal breech delivery for singleton term pregnancies in a carefully selected
Cameroonian population: a cohort study.

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Abstract

Background and objectives: Vaginal breech delivery (VBD) is known to be associated with more perinatal complications. Very few studies on the subject have been carried out in poor resource settings. The aim of this study was to determine maternal and neonatal outcomes in carefully selected cases of VBD for singleton term pregnancies in a tertiary centre in Cameroon.

Design: A retrospective cohort study

Setting: A tertiary hospital in Yaounde (Centre region of Cameroon)

Participants: Cases of VBD of newborns weighing 2500 – 3500g were matched in a ratio of 1:4 to consecutive vaginal cephalic deliveries (VCD) of newborns weighing 2500 – 3500g over a five-year period. Both groups were matched for maternal age and parity. We excluded cases of multiple gestations, footling breech, clinically inadequate maternal pelvis, preterm delivery, delivery after 41 weeks of gestation, foetal demise prior to the onset of labour, placenta praevia and foetal anomaly incompatible with vaginal delivery.

Outcome measures: Neonatal and maternal adverse outcomes of VBD observed till six weeks after delivery. Bonferroni adjusted p-values were calculated in order to reduce the chance of obtaining false-positive results.

Results: Fifty-three (53) VBD were matched against 212 VCD. Women who underwent VBD were three-fold more likely to have prolonged labour ($p=0.000001$), four-fold more likely to have meconium stained amniotic fluid ($p=0.000001$), and their newborns were about five-fold as likely to suffer from birth asphyxia ($p=0.000001$).

Conclusion: When specific protocols are applied, VBD of singleton term pregnancies is still associated with adverse outcomes in this setting. This finding does not discount the role of VBD in low-income countries, but we emphasize the need for specific precautions like close monitoring of labour and adequate anticipation for neonatal resuscitation in order to reduce these complications.

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Keywords: breech, vaginal delivery, cephalic presentation, singleton term pregnancies, outcome, Cameroon.

Strengths and limitations:

- The use of guidelines to select cases of vaginal breech delivery in order to decrease the risk of selection bias in the findings obtained.
- Bias was further reduced by calculating Bonferroni adjusted p-values.
- The study had a retrospective nature of data collection, which was subject to a potential risk of incorrectly completed records.
- The study was carried out in a single centre with standards of a tertiary level of care, which implies cautious generalization of results to health facilities not having the same level of care.

Introduction:

Breech presentations represent 3 – 4% of all foetal presentations at term [1]. Vaginal breech deliveries (VBD) are associated with a ten-fold increase in perinatal mortality when compared to vaginal cephalic deliveries (VCD) [2].

The safest mode of delivery in case of breech presentation has long been a debate in obstetrics [3]. It is recommended to carry out elective caesarean section rather than vaginal delivery for singleton term breech pregnancies when there is foetal distress, macrosomia, footling breech presentation, clinically inadequate maternal pelvis, growth-restricted baby, placenta praevia or foetal anomaly incompatible with vaginal delivery, or if an experienced clinician is absent or the clinician lacks adequate expertise for VBD [4–6]. Evidence abounds that unlike VBD for singleton term pregnancies, elective caesarean section reduces perinatal mortality and morbidity, as well as maternal morbidity (urinary incontinence and postpartum perineal pains) in developed countries [7]. However, in developing countries, the outcomes of

both VBD and elective caesarean breech delivery appear comparable [7], possibly due to the prevailing expertise of birth attendants in VBD in these resource-challenged settings [3]. Furthermore, it has been shown that as much as 39 caesarean sections are required to prevent one neonatal death or adverse neonatal outcome in low-income countries compared to seven caesarean sections needed in high-income settings [3]. Hence, a health policy generalizing the indication of caesarean section to all breech presentations in low-income countries would require significant additional investments in their health care systems. Also, the presence of a scarred uterus puts subsequent pregnancies at increased risk of complications such as placenta praevia, placenta accreta and placenta abruption, uterine rupture, repeat caesarean section and repeat breech presentation [8–10]. Likewise, elective caesarean section for breech presentation cannot be performed in all resource-limited settings due to its financial cost and the prevalent inadequate surgical infrastructure in most health facilities [7].

As such, external cephalic version for singleton term pregnancies has been recommended as a safe and cost-effective means to revert breech to cephalic presentation and avert the resort to either VBD or caesarean sections [11]. However, external cephalic version is not routinely performed in clinical practice because many health personnel lack its mastery or unduly perceive it to be associated with adverse perinatal outcomes [12]. Thus, vaginal delivery is still the main route of delivery in resource-limited environments. Data on vaginal breech delivery for singleton term pregnancies in sub-Saharan Africa is scarce, thus, explaining the lack of consensus on the management of this foetal presentation in the continent. The aim of this study was to investigate the maternal and neonatal outcomes of vaginal delivery of singleton term foetus in breech presentation following strict selection criteria in a tertiary centre of Cameroon.

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100 **Materials and Methods**

101 *Study design and setting*

102 In this cohort study, we retrospectively reviewed all pregnant women at term who had a VBD
103 and pregnant women at term with VCD at the maternity of the Yaounde Gynaeco-Obstetric
104 and Pediatric Hospital (YGOPH) between 1st January 2012 to 31st December 2016. The
105 YGOPH is a tertiary hospital located in Yaoundé, the political capital of Cameroon. This
106 health facility serves as a major referral centre for mother and child care in Yaounde and its
107 environs. In this hospital, it is a policy for an experienced obstetrician to be present for every
108 vaginal breech delivery.

109 *Participants, sampling and follow-up.*

110 The selection criteria used for cases of VBD were described in guidelines of the International
111 Federation of Obstetricians and Gynaecology[6], the Royal College of Obstetricians and
112 Gynaecologists [5] , and the Society of Obstetricians and Gynaecologists of Canada [4]. Each
113 case of VBD of newborn weighing 2500 – 3500g was matched for maternal age and parity to
114 four consecutive VCD of newborns weighing 2500 – 3500g. We excluded all pregnant
115 women with multiple gestations, footling breech presentation, clinically inadequate maternal
116 pelvis, preterm delivery (fewer than 37 weeks of gestation), pregnancies older than 41 weeks,
117 known cases of foetal demise prior to the onset of labour. Additional exclusion criteria were
118 the presence of a major foetal congenital anomaly (like anencephaly, congenital heart
119 diseases, hydrocephalus), or if there was a contraindication to vaginal delivery such as
120 placenta praevia. In both VBD and VCD groups, we excluded cases of vaginal delivery
121 converted to caesarean delivery. In both groups, women and their newborns were
122 retrospectively followed-up till six weeks after delivery, corresponding to the end of the
123 puerperal period for women and the next vaccination schedule for newborns.

124 ***Data collection and variables.***

125 From the delivery registers and the neonatal discharge chart respectively, all term singleton
126 breech deliveries and all term breech delivered babies transferred to the neonatal unit were
127 identified. Their medical records were then retrieved from the hospital archives for data
128 extraction. The variables studied were:

- 129 ▪ **Maternal demographic data:** maternal age, marital status and profession.
- 130 ▪ **Obstetric history:** parity, number of antenatal care visits and follow-up of pregnancy
- 131 ▪ **Details of labour:** foetal presentation, foetal heart rhythm, premature rupture of
132 membranes, umbilical cord prolapse, uterine contractions, colour of amniotic fluid,
133 duration of labour, episiotomy, perineal tears, APGAR score at the 5th minute and
134 birth injuries, perinatal deaths.
- 135 ▪ **Follow-up data:** the occurrence of postpartum haemorrhage, urinary or faecal
136 incontinence in women, and perinatal mortality for newborns.

137 ***Data management and statistical analysis***

138 Data was entered in Epi Info 7.1.3.3 software. Comparison of variables between pregnant
139 women who had VBD and VCD was done using the Chi-square test or Fisher exact test
140 where appropriate. Relative risks (RR) and their corresponding 95% confidence intervals
141 (95% CI) were calculated in order to measure associations. The original alpha-value was set
142 at 0.05. In order to reduce the chance of obtaining a false-positive results from the multiple
143 analyses performed on the same dependent variable, Bonferroni adjusted p-values were
144 calculated by dividing the alpha-value by the number of comparisons. Hence, any comparison
145 was statistically significant if it was inferior to the Bonferroni adjusted p-value. Patients lost
146 of follow-up were excluded from the final analysis. Also, variables with too much missing

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data precluding meaningful analyses were excluded.

Ethical consideration

The study was approved by the Institutional Review Board of the Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon.

Results

Demographic and obstetrical characteristics

During the five-year review period, a total of 13, 695 deliveries were recorded. Among these deliveries, 364 breech deliveries occurred, giving an incidence of 26.6 per 1000 deliveries. After strict application of our eligibility criteria, we retained the files of 53 women with singleton term vaginal breech deliveries of babies weighing between 2500 - 3500g (Figure 1). These women were matched to 212 women with singleton term VCD of newborns weighing between 2500 - 3500g during the same study period. There were 35 frank breech presentations (66%) and complete breech in 18 cases (34%). The maternal ages ranged from 15 to 45 years and the most frequent age group was 26 – 35 years (51.3%). Half had attended at least four antenatal care visits, 54.7% were unemployed and 45.3% were married (table 1).

Maternal outcomes

Unlike pregnant women who had VCD, those who underwent VBD were about twice as likely to have premature rupture of membranes (p=0.0337), three-fold more likely to have prolonged labour (p=0.000001), four-fold more likely have meconium stained amniotic fluid (p=0.000001) and two-fold more likely to have postpartum haemorrhage (p=0.0124). After

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3 168 Bonferroni adjustment (p-value < 0.00625), only prolonged labour and meconium stained
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5 169 amniotic fluid were retained as adverse maternal outcomes of VBD (table 2).
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8 170 *Neonatal outcomes*

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11 171 Compared to babies born of VCD, those delivered through VBD were twice as likely to have
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13 172 foetal distress (p=0.0153), were about four-fold more likely to have brachial plexus injury
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15 173 (p=0.0262) and about five-fold as likely to suffer from birth asphyxia (p=0.000001). Only
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17 174 birth asphyxia was retained as an adverse neonatal outcome after Bonferroni correction (p <
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19 175 0.0125) (table 3).
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22 176 **Discussion**

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26 177 This study aimed at determining the maternal and neonatal outcomes of vaginal breech
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28 178 delivery for singleton term pregnancies in a referral mother and child hospital in the capital
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30 179 city of Cameroon. We found that pregnant women undergoing VBD were more likely to have
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32 180 prolonged labour (p=0.000001) and meconium stained amniotic fluid (p=0.000001), while
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34 181 their newborns were more likely to suffer from birth asphyxia (p=0.000001).
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39 182 The eligibility criteria were, singleton term live breech foetus with normal birth weight (2500
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41 183 – 3500g) and absence of the following criteria; multiple gestations, footling breech
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43 184 presentation, preterm delivery, pregnancies older than 41 weeks, foeto-pelvic disproportion,
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45 185 major or lethal foetal congenital anomaly (like anencephaly, congenital heart diseases,
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47 186 hydrocephalus), foetal demise prior to the onset of labour and other contraindications to
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49 187 vaginal delivery such as placenta praevia. Despite the application of these criteria in the
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51 188 selection of cases, VBD was found to be significantly associated with prolonged labour,
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53 189 meconium stained amniotic fluid and birth asphyxia. Our observation could be the result of
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56 190 the high incidence of dystocia associated with this presentation.
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191 The findings in this study indicate that the perinatal mortality in VBD was comparable to that
192 of VCD (2% vs 0%; $p=0.2$). This may be attributed to the fact that the study was carried out
193 in referral hospital with an experienced obstetric team and with means of electronic foetal
194 monitoring (cardiotocography) to timely detect warning signs during vaginal breech birth.
195 These results are consistent with the studies reporting no difference in the perinatal mortality
196 following breech delivery in resource-limited settings [13,14]. On the other hand, Kemfang et
197 al [15] in a similar study setting in Cameroon reported a significant perinatal mortality
198 ($p<0.01$) for breech deliveries, which could be due to the absence of well-defined selection
199 criteria for vaginal breech delivery in their series. Their observed perinatal mortality was in
200 cases of macrosomia, nuchal extension, dystocic labour and placental abruption, which were
201 all excluded in the current cohort.

202 Babies born through VBD were more likely to have birth asphyxia than those who had a
203 vaginal cephalic birth (47% vs. 8%; $p = 0.000001$), corroborating previous studies from both
204 high-income [3,16] and low-income settings [13,14,17]. This could be related to the fact that
205 breech foetuses face an increased risk of hypoxic-anoxic events from head entrapment, rapid
206 decompression of the head, and other birth trauma [7].

207 The main limitation of this study is its retrospective nature of data collection, which was
208 subject to a potential risk of incorrectly completed records. Also, the study was conducted in
209 an urban centre with standards of a tertiary level of care, which implies cautious
210 generalization of our results to health facilities not having the same level of care in rural
211 settings. Nevertheless, based on careful selection criteria of singleton term VBD and a robust
212 statistical analysis to eliminate bias, we reviewed a five-year period to assess the outcomes of
213 VBD in a low-income country where caesarean delivery cannot be generalized as the route of
214 delivery for all breech presentations because of its financial cost and the prevalent inadequate

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3 215 surgical infrastructure in most health facilities. Our finding is a significant contribution to the
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5 216 on-going debate on the safety of vaginal breech delivery in sub-Saharan Africa.
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8 217 **Conclusion**

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11 218 Our findings suggest when breech delivery guidelines are applied, VBD of singleton term
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13 219 pregnancies is still associated with a three-fold risk of prolonged labour, a four-fold risk of
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15 220 meconium stained amniotic fluid, and a five-fold risk of birth asphyxia. This finding does not
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17 221 discount the role of VBD in resource-poor settings, but we emphasize the need for specific
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19 222 precautions like close monitoring of labour and adequate anticipation for neonatal
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21 223 resuscitation in order to reduce these complications. Also, elective caesarean section should
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23 224 be performed for singleton breech term pregnancies whenever possible. This would need to
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25 225 be further explored in large multicentre clinical trials in our resource-constrained settings.
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34
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40 230 data analysis and interpretation, manuscript writing and critical revisions. FM: Study
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42 231 conception and design, acquisition of data, data analysis and interpretation and manuscript
43
44 232 writing. JNT, MNT, RT and VA: Acquisition of data, data analysis and interpretation,
45
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Competing interests: We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests.

Ethical Approval: The study was approved by the Institutional Review Board of the Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon.

Data sharing statement: Data available from the following Dryad Digital Repository; <http://dx.doi.org/10.5061/dryad.cf3mp>

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Figure and Table Legend

Figure 1: Flow chart depicting selection of vaginal breech delivery cases.

Table 1: Socio-demographic characteristics and obstetric history of mothers

Table 2: Maternal outcomes of vaginal breech delivery

Table 3: Analysis of neonatal outcomes associated with vaginal breech delivery

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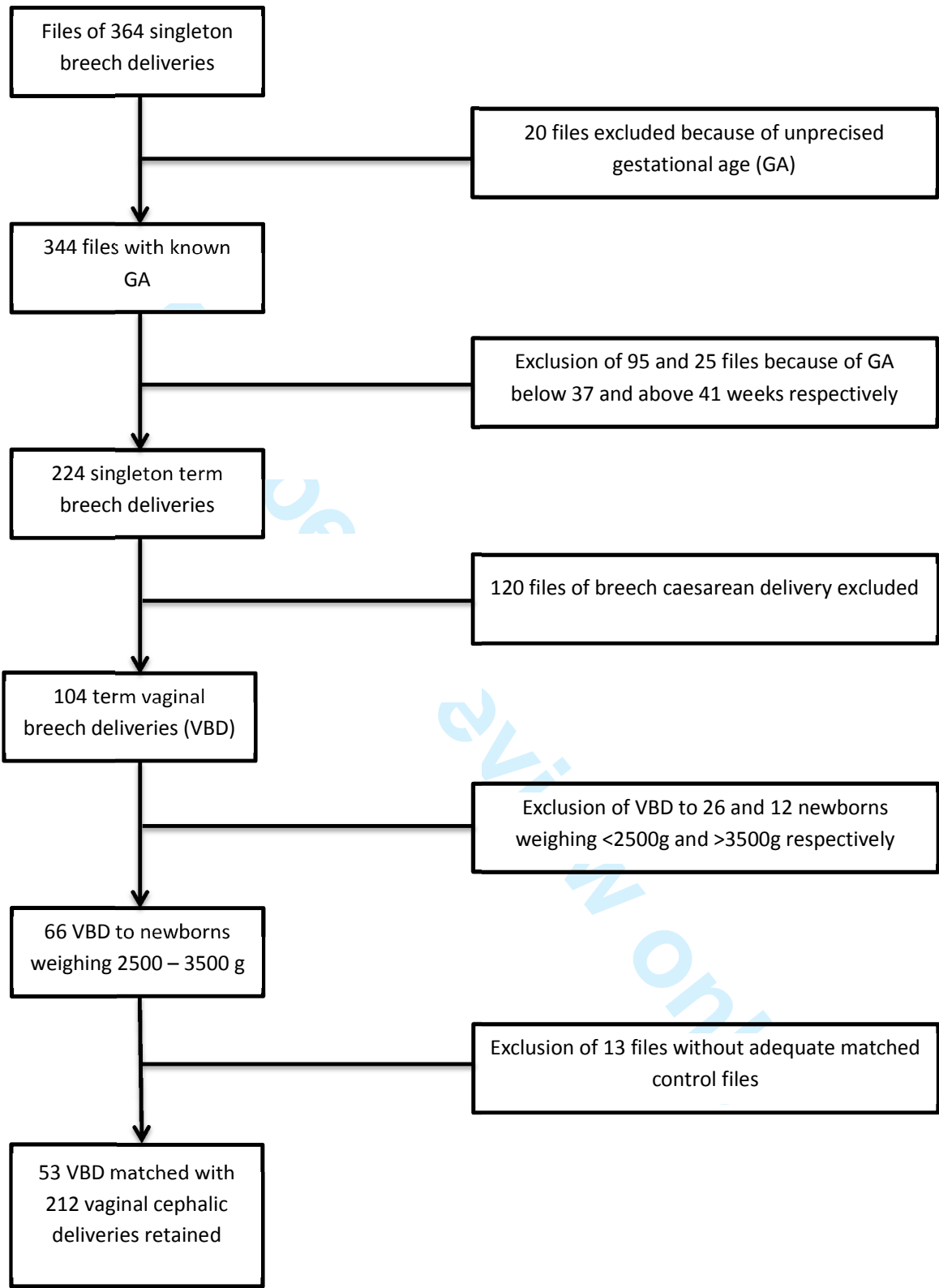


Figure 1: Flow chart depicting selection of vaginal breech delivery cases.

Table 1: Socio-demographic characteristics and obstetric history of mothers

Groups	Number	Frequency (%)
Maternal age groups (N=265) (years)		
15 – 25	99	37.4
26 – 35	136	51.3
35 - 45	30	11.3
Type of breech presentation (N=53)		
Frank breech	35	66
Complete breech	18	34
Occupation (N=265)		
Unemployed	145	54.7
Employed	72	27.2
Self-employed	48	18.1
Marital status (N=264)		
Married	120	45.3
Single	117	44.2
Cohabitation	27	10.2
Parity (N=265)		
Nulliparous (parity = 0)	104	39.3
Primiparous (parity = 1)	60	22.6
Multiparous (parity > 1)	101	38.1
Number of antenatal care visits (N=262)		
≥ 4	135	51
< 4	127	48

Table 2: Maternal outcomes of vaginal breech delivery

Variables	Vaginal breech delivery (n=53)	Vaginal cephalic delivery (n=212)	Relative risk	95% confidence interval	p-value
Premature rupture of membranes					
Yes	13 (24.5%)	28 (13%)	1.77	1.04-3.02	0.0337
No	40 (75.5%)	184 (87%)			
Meconium stained amniotic fluid					
Yes	13 (24.5%)	5 (2.4%)	4.46	2.98-6.67	0.000001
No	40 (75.5%)	207 (97.6)			
Umbilical cord prolapse					
Yes	2 (4%)	1 (0.5%)	3.42	1.48-7.91	0.1029
No	51 (96%)	211 (99.5%)			
Prolonged labour (> 12 hours)					
Yes	25 (47%)	28 (13%)	3.57	2.28-5.58	0.000001
No	28 (53%)	184 (87%)			
Episiotomies					
Yes	3 (5.7%)	22 (10.4%)	0.57	0.19-1.71	0.4312
No	50 (94.3%)	190 (89.6%)			
Perineal tears					
Yes	17 (32%)	64 (30%)	1.07	0.64-1.79	0.7897
No	36 (68%)	148 (70%)			
Uterine atony					
Yes	1 (2%)	5 (2.4%)	0.83	0.13-5.05	1.0000
No	52 (98%)	207 (97.6%)			
Postpartum haemorrhage					
Yes	7 (13.2%)	10 (4.7%)	2.21	1.18-4.14	0.0124
No	46 (86.8%)	202 (95.3%)			

Bonferroni corrected p-value < 0.00625.

Table 3: Analysis of neonatal outcomes associated with vaginal breech delivery

Neonatal outcomes	Vaginal breech delivery (n=53)	Vaginal cephalic delivery (n=212)	Relative risk	95% confidence interval	p-value
Foetal distress					
Yes	9 (17%)	15 (7%)	2.05	1.14-3.67	0.0153
No	44 (83%)	197 (93%)			
Neonatal asphyxia					
Yes	25 (47.2%)	17 (8.0%)	4.74	3.09-7.26	0.000001
No	28 (52.8%)	195 (92%)			
Brachial plexus injury					
Yes	3 (5.7%)	01(0.5%)	3.91	2.11-7.26	0.0262
No	50 (94.3%)	211 (99.5%)			
Perinatal deaths					
Yes	1 (2%)	00	5.07	3.98-6.47	0.2
No	52 (98%)	212 (100%)			

Bonferroni corrected p-value < 0.0125.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	Page 1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Pages 3 and 4
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Pages 5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Page 5
		(b) For matched studies, give matching criteria and number of exposed and unexposed	Page 5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 6
Bias	9	Describe any efforts to address potential sources of bias	Page 6
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Page 6
		(b) Describe any methods used to examine subgroups and interactions	-
		(c) Explain how missing data were addressed	Page 6
		(d) If applicable, explain how loss to follow-up was addressed	Page 6
		(e) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 7 and 13
		(b) Give reasons for non-participation at each stage	Page 7 and 13
		(c) Consider use of a flow diagram	Page 13
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 7 and 14
		(b) Indicate number of participants with missing data for each variable of interest	Page 7 and 13
		(c) Summarise follow-up time (eg, average and total amount)	Page 7
Outcome data	15*	Report numbers of outcome events or summary measures over time	Pages 7 and 8
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Pages 7, 8, 15 and 16
		(b) Report category boundaries when continuous variables were categorized	-
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 8
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pages 8 and 9
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Not applicable

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Maternal and neonatal outcomes of vaginal breech delivery for singleton term pregnancies in a carefully selected Cameroonian population: a cohort study.

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Title:

Maternal and neonatal outcomes of vaginal breech delivery for singleton term pregnancies in a carefully selected Cameroonian population: a cohort study.

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Abstract

Background and objectives: Vaginal breech delivery (VBD) is known to be associated with more perinatal and maternal complications. Very few studies on the subject have been carried out in poor resource settings. The aim of this study was to determine maternal and neonatal outcomes in carefully selected cases of VBD for singleton term pregnancies in a tertiary centre in Cameroon.

Design: A retrospective cohort study

Setting: A tertiary hospital in Yaounde, Cameroon

Participants: Cases of VBD of newborns weighing 2500 – 3500g were matched in a ratio of 1:4 to consecutive vaginal cephalic deliveries (VCD) of newborns weighing 2500 – 3500g over a five-year period. Both groups were matched for maternal age and parity. We excluded cases of multiple gestations, footling breech, clinically inadequate maternal pelvis, preterm delivery, post term pregnancies, foetal demise prior to the onset of labour, placenta praevia and foetal anomaly incompatible with vaginal delivery.

Outcome measures: Neonatal and maternal adverse outcomes of VBD observed till six weeks after delivery analysed using Bonferroni correction.

Results: Fifty-three (53) VBD were matched against 212 VCD. Unlike women who had VCD, those who underwent VBD were more likely to have prolonged labour (OR: 8.05; 95% CI: 3.00-11.47; $p < 0.001$), emission of meconium stained amniotic fluid (OR: 13.45; 95% CI: 4.54-39.84; $p < 0.001$), and their newborns were more likely to suffer from birth asphyxia (OR: 10.24; 95% CI: 4.92-21.31; $p < 0.001$).

Conclusion: The study infers a strong association between VBD of singleton term pregnancies and maternofoetal morbidity when specific protocols are applied. This however, failed to translate into higher differences in perinatal mortality. This finding does not discount the role of VBD in low-income countries, but we emphasize the need for specific precautions like close monitoring of labour and adequate anticipation for neonatal resuscitation in order to reduce these complications.

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Keywords: breech, vaginal delivery, cephalic presentation, singleton term pregnancies, outcome, Cameroon.

Strengths and limitations:

- The use of guidelines to select cases of vaginal breech delivery in order to decrease the risk of selection bias in the findings obtained.
- Bias was further reduced by calculating Bonferroni adjusted p-values.
- The study had a retrospective nature of data collection, which was subject to a potential risk of incorrectly completed records.
- The study was carried out in a single centre with standards of a tertiary level of care, which implies cautious generalization of results to health facilities not having the same level of care.

Introduction:

Breech presentations represent 3 – 4% of all foetal presentations at term [1]. Vaginal breech deliveries (VBD) are associated with a ten-fold increase in perinatal mortality when compared to vaginal cephalic deliveries (VCD) [2].

The safest mode of delivery in case of breech presentation has long been a debate in obstetrics [3]. It is recommended to carry out elective caesarean section rather than vaginal delivery for singleton term breech pregnancies when there is foetal distress, macrosomia, footling breech presentation, clinically inadequate maternal pelvis, growth-restricted baby, placenta praevia or foetal anomaly incompatible with vaginal delivery, or if an experienced clinician is absent or the clinician lacks adequate expertise for VBD [4–6]. Evidence abounds that unlike VBD for singleton term pregnancies, elective caesarean section reduces perinatal mortality and morbidity, as well as maternal morbidity (urinary incontinence and postpartum perineal pains) in developed countries [7]. However, in resource-limited countries, the

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3 78 outcomes of both VBD and elective caesarean breech delivery appear comparable [7],
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5 79 possibly due to the prevailing expertise of birth attendants in VBD in these resource-
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7 80 challenged settings [3]. Furthermore, it has been shown that as much as 39 caesarean sections
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9 81 are required to prevent one neonatal death or adverse neonatal outcome in low-income
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11 82 countries compared to seven caesarean sections needed in high-income settings [3]. Hence, a
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13 83 health policy generalizing the indication of caesarean section to all breech presentations in
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15 84 low-income countries would require significant additional investments in their health care
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17 85 systems. Also, the presence of a scarred uterus puts subsequent pregnancies at increased risk
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19 86 of complications such as placenta praevia, placenta accreta and placenta abruption, uterine
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21 87 rupture, repeat caesarean section and repeat breech presentation [6,8–11]. Likewise, elective
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23 88 caesarean section for breech presentation cannot be performed in all resource-limited settings
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25 89 due to its financial cost and the prevalent inadequate surgical infrastructure in most health
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27 90 facilities [7].
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33 91 As such, external cephalic version for singleton term pregnancies has been recommended as a
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35 92 safe and cost-effective means to revert breech to cephalic presentation and avert the resort to
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37 93 either VBD or caesarean sections [12]. However, external cephalic version is not routinely
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39 94 performed in clinical practice because many health personnel lack its mastery or unduly
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41 95 perceive it to be associated with adverse perinatal outcomes [13]. Thus, vaginal delivery is
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43 96 still the main route of delivery in resource-limited environments. Data on vaginal breech
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45 97 delivery for singleton term pregnancies in sub-Saharan Africa is scarce, thus, explaining the
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47 98 lack of consensus on the management of this foetal presentation in the continent. The aim of
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49 99 this study was to investigate the maternal and neonatal outcomes of vaginal delivery of
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51 100 singleton term foetus in breech presentation following strict selection criteria in a tertiary
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55 101 centre of Cameroon.
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102 **Materials and Methods**

103 *Study design and setting*

104 In this cohort study, we retrospectively reviewed case notes of all pregnant women at term
105 who had a VBD and pregnant women at term with VCD at the maternity of the Yaounde
106 Gynaeco-Obstetric and Pediatric Hospital (YGOPH) between 1st January 2012 to 31st
107 December 2016. The YGOPH is a tertiary hospital located in Yaoundé, the political capital of
108 Cameroon. This health facility serves as a major referral centre for mother and child care in
109 Yaounde and its environs. The maternity unit is taken care of by 12 obstetricians-
110 gynaecologists and 21 midwives.

111 *Participants, sampling and follow-up.*

112 The cases were selected based on the guidelines of the Obstetricians and Gynaecologists of
113 Canada [4], the Royal College of Obstetricians and Gynaecologists [6] and the International
114 Federation of Obstetricians and Gynaecology [5]. The minimal sample size was calculated
115 assuming a VBD prevalence rate of 3% [1] and a precision of 5% [14], hence a minimum of
116 48 cases of VBD required. Each case of VBD of newborn weighing 2500 – 3500g was
117 matched for maternal age and parity to four consecutive VCD of newborns weighing 2500 –
118 3500g. We excluded all pregnant women with multiple gestations, footling breech
119 presentation, clinically inadequate maternal pelvis, preterm delivery (less than 37 weeks of
120 gestation), post term pregnancies (\geq 41 weeks of gestation), known cases of foetal demise
121 prior to the onset of labour. Additional exclusion criteria were the presence of a major foetal
122 congenital anomaly (like anencephaly, congenital heart diseases, hydrocephalus), or if there
123 was a contraindication to vaginal delivery such as placenta praevia. In both VBD and VCD
124 groups, we excluded cases of vaginal delivery converted to caesarean delivery. In both
125 groups, women and their newborns were followed-up retrospectively till six weeks after

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3 126 delivery, corresponding to the end of the puerperal period for women and the next
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5 127 vaccination schedule for newborns.
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8 128 ***Management of delivery***
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11 129 In this hospital, it is a policy for an experienced obstetrician was present for every VBD and
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13 130 to augment breech labour only with oxytocin. All deliveries occurred with women lying in
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15 131 the recumbent position with legs in holders. Foetal hand monitoring electronically by means
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17 132 of a cardiotocography machine.
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22 133 ***Data collection and variables.***
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25 134 We identified the records of all women-newborn couple for term singleton breech deliveries
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27 135 using the delivery registers. Their medical records were then retrieved from the hospital
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29 136 archives for data extraction. The variables studied were:
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33 137 ▪ **Maternal demographic data:** maternal age, marital status and profession.
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35 138 ▪ **Obstetric history:** parity, number of antenatal care visits and follow-up of pregnancy
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37 139 ▪ **Details of labour:** foetal presentation, foetal heart rhythm, premature rupture of
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39 140 membranes, umbilical cord prolapse, uterine contractions, colour of amniotic fluid,
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41 141 duration of labour, episiotomy, perineal tears, APGAR score at the 5th minute and
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43 142 birth injuries, perinatal deaths.
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45 143 ▪ **Follow-up data:** the occurrence of postpartum haemorrhage, urinary or faecal
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47 144 incontinence in women, and perinatal mortality for newborns.
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147 **Definition of terms**

148 Brachial plexus injury was defined as any paralysis of the muscles of the shoulder girdle,
149 arm, forearm of the newborn and occurring after dystocia (difficult childbirth). It was
150 diagnosed by the attending obstetrician or midwife at birth and confirmed by a paediatrician
151 during the first physical examination of the newborn within 24 hours of birth. Birth asphyxia
152 was diagnosed based on the Modified Sarnat-Sarnat Score [15] and a five-minute Apgar
153 score ≤ 3 associated with neurological signs such as hypotonia, coma or convulsions [16].
154 The length of labour was the estimated time period from 4 cm cervical dilatation to expulsion
155 of the foetus. For all deliveries, this time interval was monitored and recorded on a
156 partogram. Foetal Distress was defined as the occurrence of foetal tachycardia (foetal heart
157 beats > 160 beats/min) or foetal bradycardia (< 110 beats/min) [17]. PPH was defined as an
158 estimated blood loss greater than 500 ml within 24 hours after vaginal delivery [18].

159 ***Data management and statistical analysis***

160 Data was entered in Epi Info 7.1.3.3 software. Comparison of variables between pregnant
161 women who had VBD and VCD was done using the Chi-square test or Fisher exact test
162 where appropriate. Odds ratios (OR) and their corresponding 95% confidence intervals (95%
163 CI) were calculated in order to measure associations. The original alpha-value was set at
164 0.05. In order to reduce the chance of obtaining a type 1 error from the multiple analyses
165 performed on the same dependent variable, Bonferroni adjusted p-values were calculated by
166 dividing the alpha-value by the number of comparisons. Hence, any comparison was
167 statistically significant if it was inferior to the Bonferroni adjusted p-value. Variables with too
168 much missing data precluding meaningful analyses were excluded.

169

170 *Ethical consideration*

171 The study was approved by the Institutional Review Board of the Faculty of Medicine and
172 Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon.

173

174 **Results**

175 *Demographic and obstetrical characteristics*

176 During the five-year review period, a total of 13, 695 deliveries were recorded. Among these
177 deliveries, 364 breech deliveries occurred, giving an incidence of 26.6 per 1000 deliveries.
178 After strict application of our eligibility criteria, we retained the files of 53 women with
179 singleton term vaginal breech deliveries of babies weighing between 2500 - 3500g (Figure 1).
180 Of the 53 VBD, 12 (22.6%) were unexpected breech births diagnosed during labour in the
181 delivery room and nine (17%) vaginal breech births required forceps delivery. These women
182 were matched to 212 women with singleton term VCD of newborns weighing between 2500 -
183 3500g during the same study period. There were 35 frank breech presentations (66%) and
184 complete breech in 18 cases (34%). The maternal ages ranged from 15 to 45 years and the
185 most frequent age group was 20 – 30 years (54.7%). Half had attended at least four antenatal
186 care visits, 54.7% were unemployed and 45.3% were married. Both VBD and VCD groups
187 showed similarities in maternal age, parity, marital and employment status (table 1).

188 *Maternal outcomes*

189 Unlike pregnant women who had VCD, those who underwent VBD were more likely to have
190 emission of meconium stained amniotic fluid (OR: 13.45; 95% CI: 4.54-39.84; p <0.001),
191 prolonged labour (OR: 8.05; 95% CI: 3.00-11.47; p <0.001), premature rupture of

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192 membranes (OR: 2.14; 95% CI: 1.02-4.48; p = 0.0448), and postpartum haemorrhage (OR:
193 3.07; 95% CI: 1.11-8.50; p = 0.0305). After Bonferroni adjustment (p-value < 0.00556), only
194 prolonged labour, meconium stained amniotic fluid and delivery by a midwife were retained
195 as determinants of adverse maternal outcomes of VBD (table 2).

196 *Neonatal outcomes*

197 Compared to babies born of VCD, those delivered through VBD were more likely to have
198 foetal distress (OR: 2.05; 95% CI: 1.14-3.67; p = 0.0153), brachial plexus injury (OR: 3.91;
199 95% CI: 2.11-7.26; p = 0.0262), and about five-fold as likely to suffer from birth asphyxia
200 (OR: 4.74; 95% CI: 3.09-7.26; p < 0.001). Only birth asphyxia was retained as an adverse
201 neonatal outcome after Bonferroni correction (p < 0.0125) (table 3).

202 **Discussion**

203 This study aimed at determining the maternal and neonatal outcomes of vaginal breech
204 delivery for singleton term pregnancies in a tertiary mother and child hospital in the capital
205 city of Cameroon. Despite the application of the aforementioned guidelines [4–6], VBD was
206 found to be significantly associated with prolonged labour (OR: 8.05; 95% CI: 3.00-11.47; p
207 <0.001), emission of meconium stained amniotic fluid (OR: 13.45; 95% CI: 4.54-39.84; p
208 <0.001), and birth asphyxia (OR: 10.24; 95% CI: 4.92-21.31; p <0.001).

209 Despite the application of the aforementioned guidelines [4–6], VBD was found to be
210 significantly associated with prolonged labour, meconium stained amniotic fluid and birth
211 asphyxia. Our observation could be the result of the high incidence of dystocia associated
212 with this presentation [19].

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3 213 The findings in this study indicate that the perinatal mortality in VBD was comparable to that
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5 214 of VCD (2% vs 0%; $p=0.2$). This may be attributed to the fact that the study was carried out
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7 215 in referral hospital with an experienced obstetric team and with means of electronic foetal
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9 216 monitoring (cardiotocography) to timely detect warning signs during vaginal breech birth.
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11 217 These results are consistent with the studies reporting no difference in the perinatal mortality
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13 218 following breech delivery in resource-limited settings [20,21]. On the other hand, Kemfang et
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15 219 al [22] in a similar study setting in Cameroon reported a significant perinatal mortality
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17 220 ($p<0.01$) for breech deliveries, which could be due to the absence of well-defined selection
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19 221 criteria for vaginal breech delivery in their series. Their observed perinatal mortality was in
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21 222 cases of macrosomia, nuchal extension, dystocic labour and placental abruption, which were
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23 223 all excluded in the current cohort.
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29 224 Babies born through VBD were more likely to have birth asphyxia than those who had a
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31 225 vaginal cephalic birth (47% vs. 8%; $p < 0.001$), corroborating previous studies from both
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33 226 high-income [3,23] and low-income settings [20,21,24]. This could be related to the fact that
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35 227 breech foetuses face an increased risk of hypoxic-anoxic events from head entrapment, rapid
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37 228 decompression of the head, and other birth trauma [7].
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41 229 The main limitation of this study is its retrospective nature of data collection, which was
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43 230 subject to a potential risk of incorrectly completed records. Also, the study was conducted in
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45 231 an urban centre with standards of a tertiary level of care, which implies cautious
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47 232 generalization of our results to health facilities not having the same level of care in rural
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49 233 settings. Nevertheless, based on careful selection criteria of singleton term VBD and a robust
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51 234 statistical analysis to eliminate bias, we reviewed a five-year period to assess the outcomes of
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53 235 VBD in a low-income country where caesarean delivery cannot be generalized as the route of
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55 236 delivery for all breech presentations because of its financial cost and the prevalent inadequate
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surgical infrastructure in most health facilities. Our finding is a significant contribution to the on-going debate on the safety of vaginal breech delivery in sub-Saharan Africa.

Conclusion

Our findings suggest when breech delivery guidelines are applied, VBD of singleton term pregnancies is still associated with a three-fold risk of prolonged labour, a four-fold risk of meconium stained amniotic fluid, and a five-fold risk of birth asphyxia. This finding does not discount the role of VBD in resource-poor settings, but we emphasize the need for specific precautions like close monitoring of labour and adequate anticipation for neonatal resuscitation in order to reduce these complications. Also, elective caesarean section should be performed for singleton breech term pregnancies whenever possible. This would need to be further explored in large multicentre clinical trials in our resource-constrained settings.

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Authors' contributions: JSD, PF and EM: Study conception and design, acquisition of data, data analysis and interpretation, manuscript writing and critical revisions. FM: Study conception and design, acquisition of data, data analysis and interpretation and manuscript writing. JNT, MNT, RT and VA: Acquisition of data, data analysis and interpretation, manuscript writing and revisions. All authors read and approved the final manuscript.

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Competing interests: We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests.

Ethical Approval: The study was approved by the Institutional Review Board of the Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon.

Data sharing statement: No additional data are available.

Figure and Table Legend

Figure 1: Flow chart depicting selection of vaginal breech delivery cases.

Table 1: Socio-demographic characteristics and obstetric history of mothers

Table 2: Maternal outcomes of vaginal breech delivery

Table 3: Analysis of neonatal outcomes associated with vaginal breech delivery

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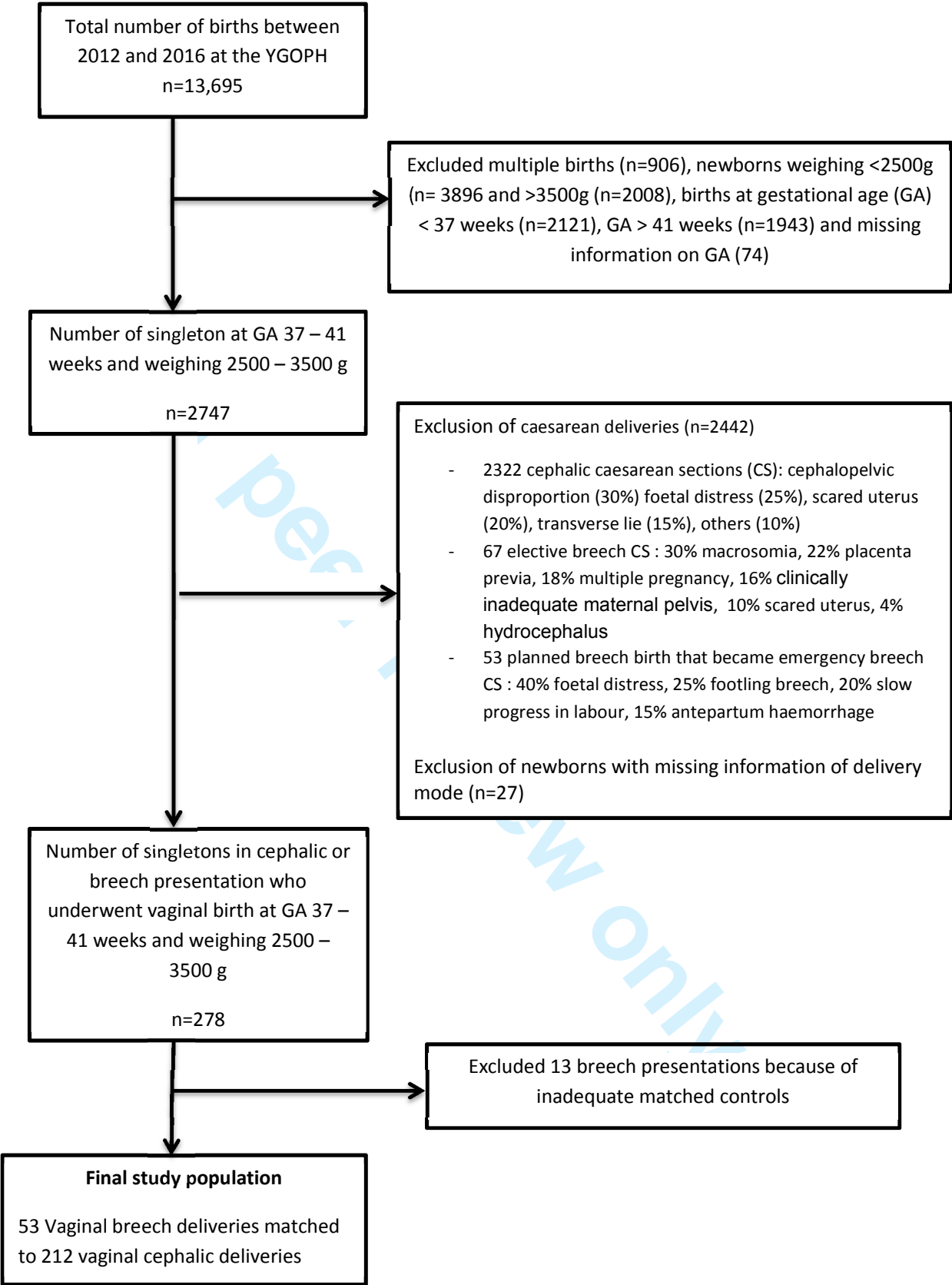
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378 **Table 1: Socio-demographic characteristics and obstetric history of mothers**

Groups	Number (%)	Vaginal breech delivery (n=53)	Vaginal cephalic delivery (n=212)	p-value
Maternal age groups (years)				
< 20	31 (11.7%)	6	25	0.3068
20 - 30	145(54.7%)	25	120	
30 - 40	85(32.1%)	20	65	
>40	4 (1.5%)	2	2	
Occupation*				
Unemployed	145 (54.7%)	31	114	0.3323
Employed	72 (27.2%)	10	62	
Self-employed	47 (18.1%)	11	36	
Marital status*				
Married	120 (45.3%)	28	96	0.4414
Single	117 (44.2%)	18	94	
Cohabitation	27 (10.2%)	6	22	
Parity				
Nulliparous (parity = 0)	104 (39.3%)	18	86	0.6199
Primiparous (parity = 1)	60 (22.6%)	12	48	
Multiparous (parity > 1)	101 (38.1%)	23	78	
Number of antenatal care visits ^β				
≥ 4	135 (51%)	17	115	0.0293
< 4	127 (48%)	8	19	

*1 missing data; ^β 3 missing data

Table 2: Maternal outcomes of vaginal breech delivery

Variables	Vaginal breech delivery (n=53)	Vaginal cephalic delivery (n=212)	Odds ratio	95% confidence interval	p-value
Premature rupture of membranes					
Yes	13 (24.5%)	28 (13%)	2.14	1.02-4.48	0.0448
No	40 (75.5%)	184 (87%)			
Meconium stained amniotic fluid					
Yes	13 (24.5%)	5 (2.4%)	13.45	4.54-39.84	< 0.001
No	40 (75.5%)	207 (97.6%)			
Umbilical cord prolapse					
Yes	2 (4%)	1 (0.5%)	8.27	0.74-93.05	0.087
No	51 (96%)	211 (99.5%)			
Prolonged labour (> 12 hours)					
Yes	25 (47%)	28 (13%)	8.05	3.00-11.47	< 0.001
No	28 (53%)	184 (87%)			
Course of labour					
Augmented with oxytocin	2 (4%)	15 (7.1%)	0.52	0.11-2.33	0.3882
Spontaneous	51 (96%)	197 (92.9%)			
Episiotomies					
Yes	3 (5.7%)	22 (10.4%)	0.52	0.15-1.80	0.301
No	50 (94.3%)	190 (89.6%)			
Perineal tears					
Yes	17 (32%)	64 (30%)	1.09	0.57-2.09	0.7897
No	36 (68%)	148 (70%)			
Uterine atony					
Yes	1 (2%)	5 (2.4%)	0.79	0.09-6.96	0.8368
No	52 (98%)	207 (97.6%)			
Postpartum haemorrhage					
Yes	7 (13.2%)	10 (4.7%)	3.07	1.11-8.50	0.0305
No	46 (86.8%)	202 (95.3%)			

Bonferroni corrected p-value < 0.00556.

399 **Table 3: Analysis of neonatal outcomes associated with vaginal breech delivery**

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Neonatal outcomes	Vaginal breech delivery (n=53)	Vaginal cephalic delivery (n=212)	Odds Ratio	95% confidence interval	p-value
Foetal distress					
Yes	9 (17%)	15 (7%)	2.69	1.11-6.53	0.0293
No	44 (83%)	197 (93%)			
Neonatal asphyxia					
Yes	25 (47.2%)	17 (8.0%)	10.24	4.92-21.31	< 0.001
No	28 (52.8%)	195 (92%)			
Brachial plexus injury					
Yes	3 (5.7%)	01(0.5%)	12.66	1.28-124.28	0.0262
No	50 (94.3%)	211 (99.5%)			
Perinatal deaths					
Yes	1 (2%)	00	12.14	0.49-302.36	0.128
No	52 (98%)	212 (100%)			

401 Bonferroni corrected p-value < 0.0125.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	Page 1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Pages 3 and 4
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Pages 5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Page 5
		(b) For matched studies, give matching criteria and number of exposed and unexposed	Page 5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 6
Bias	9	Describe any efforts to address potential sources of bias	Page 6
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Page 6
		(b) Describe any methods used to examine subgroups and interactions	-
		(c) Explain how missing data were addressed	Page 6
		(d) If applicable, explain how loss to follow-up was addressed	Page 6
		(e) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 7 and 13
		(b) Give reasons for non-participation at each stage	Page 7 and 13
		(c) Consider use of a flow diagram	Page 13
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 7 and 14
		(b) Indicate number of participants with missing data for each variable of interest	Page 7 and 13
		(c) Summarise follow-up time (eg, average and total amount)	Page 7
Outcome data	15*	Report numbers of outcome events or summary measures over time	Pages 7 and 8
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Pages 7, 8, 15 and 16
		(b) Report category boundaries when continuous variables were categorized	-
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 8
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pages 9 and 10
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Not applicable

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Maternal and neonatal outcomes of vaginal breech delivery for singleton term pregnancies in a carefully selected Cameroonian population: a cohort study.

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Primary Subject Heading:	Obstetrics and gynaecology
Secondary Subject Heading:	Reproductive medicine
Keywords:	breech, vaginal delivery, cephalic presentation, singleton term pregnancies, outcome, Cameroon

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Manuscripts

Title:

Maternal and neonatal outcomes of vaginal breech delivery for singleton term pregnancies in a carefully selected Cameroonian population: a cohort study.

Authors:

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Abstract

Background and objectives: Vaginal breech delivery (VBD) is known to be associated with more perinatal and maternal complications. Very few studies on the subject have been carried out in poor resource settings. The aim of this study was to determine maternal and neonatal outcomes in carefully selected cases of VBD for singleton term pregnancies in a tertiary centre in Cameroon.

Design: A retrospective cohort study

Setting: A tertiary hospital in Yaounde, Cameroon

Participants: Cases of VBD of newborns weighing 2500 – 3500g were matched in a ratio of 1:4 to consecutive vaginal cephalic deliveries (VCD) of newborns weighing 2500 – 3500g over a five-year period. Both groups were matched for maternal age and parity. We excluded cases of multiple gestations, footling breech, clinically inadequate maternal pelvis, preterm delivery, post term pregnancies, foetal demise prior to the onset of labour, placenta praevia and foetal anomaly incompatible with vaginal delivery.

Outcome measures: Neonatal and maternal adverse outcomes of VBD observed till six weeks after delivery analysed using Bonferroni correction.

Results: Fifty-three (53) VBD were matched against 212 VCD. Unlike women who had VCD, those who underwent VBD were more likely to have prolonged labour (OR: 8.05; 95% CI: 3.00-11.47; $p < 0.001$), and their newborns were more likely to suffer from birth asphyxia (OR: 10.24; 95% CI: 4.92-21.31; $p < 0.001$).

Conclusion: The study infers a strong association between VBD of singleton term pregnancies and maternofoetal morbidity when specific protocols are applied. This however, failed to translate into higher differences in perinatal mortality. This finding does not discount the role of VBD in low-income countries, but we emphasize the need for specific precautions like close monitoring of labour and adequate anticipation for neonatal resuscitation in order to reduce these complications.

Keywords: breech, vaginal delivery, cephalic presentation, singleton term pregnancies, outcome, Cameroon.

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Strengths of the study:

- The use of guidelines to select cases of vaginal breech delivery in order to decrease the risk of selection bias in the findings obtained.
- Bias was further reduced by calculating Bonferroni adjusted p-values

Limitations of the study:

- The study had a retrospective nature of data collection, which was subject to a potential risk of incorrectly completed records.
- The study was carried out in a single centre with standards of a tertiary level of care, which implies cautious generalization of results to health facilities not having the same level of care.

Introduction:

Breech presentations represent 3 – 4% of all foetal presentations at term (1). Vaginal breech deliveries (VBD) are associated with a ten-fold increase in perinatal mortality when compared to vaginal cephalic deliveries (VCD) (2).

The safest mode of delivery in case of breech presentation has long been a debate in obstetrics (3). It is recommended to carry out elective caesarean section rather than vaginal delivery for singleton term breech pregnancies when there is foetal distress, macrosomia, footling breech presentation, clinically inadequate maternal pelvis, growth-restricted baby, placenta praevia or foetal anomaly incompatible with vaginal delivery, or if an experienced clinician is absent or the clinician lacks adequate expertise for VBD (4–6). Evidence abounds that unlike VBD for singleton term pregnancies, elective caesarean section reduces perinatal mortality and morbidity, as well as maternal morbidity (urinary incontinence and postpartum perineal pains) in developed countries (7). However, in resource-limited countries, the outcomes of both VBD and elective caesarean breech delivery appear comparable (7), possibly due to the prevailing expertise of birth attendants in VBD in these resource-

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3 78 challenged settings (3). Furthermore, it has been shown that as much as 39 caesarean sections
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5 79 are required to prevent one neonatal death or adverse neonatal outcome in low-income
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7 80 countries compared to seven caesarean sections needed in high-income settings (3). Hence, a
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9 81 health policy generalizing the indication of caesarean section to all breech presentations in
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11 82 low-income countries would require significant additional investments in their health care
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13 83 systems. Also, the presence of a scarred uterus puts subsequent pregnancies at increased risk
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15 84 of complications such as placenta praevia, placenta accreta and placenta abruption, uterine
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17 85 rupture, repeat caesarean section and repeat breech presentation (6,8–11). Likewise, elective
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19 86 caesarean section for breech presentation cannot be performed in all resource-limited settings
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21 87 due to its financial cost and the prevalent inadequate surgical infrastructure in most health
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23 88 facilities (7).

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28 89 As such, external cephalic version for singleton term pregnancies has been recommended as a
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30 90 safe and cost-effective means to revert breech to cephalic presentation and avert the resort to
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32 91 either VBD or caesarean sections (12). However, external cephalic version is not routinely
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34 92 performed in clinical practice because many health personnel lack its mastery or unduly
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36 93 perceive it to be associated with adverse perinatal outcomes (13). Thus, vaginal delivery is
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38 94 still the main route of delivery in resource-limited environments. Data on vaginal breech
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40 95 delivery for singleton term pregnancies in sub-Saharan Africa is scarce, thus, explaining the
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42 96 lack of consensus on the management of this foetal presentation in the continent. The aim of
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44 97 this study was to investigate the maternal and neonatal outcomes of vaginal delivery of
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46 98 singleton term foetus in breech presentation following strict selection criteria in a tertiary
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102 **Materials and Methods**

103 *Study design and setting*

104 In this cohort study, we retrospectively reviewed case notes of all pregnant women at term
105 who had a VBD and pregnant women at term with VCD at the maternity of the Yaounde
106 Gynaeco-Obstetric and Pediatric Hospital (YGOPH) between 1st January 2012 to 31st
107 December 2016. The YGOPH is a tertiary hospital located in Yaoundé, the political capital of
108 Cameroon. This health facility serves as a major referral centre for mother and child care in
109 Yaounde and its environs. Its annual number of child births varies between 2000 to 2500
110 deliveries. The YGOPH is equipped with modern equipment and personnel to provide
111 comprehensive Emergency Obstetric and Neonatal Care (EmONC) services. The maternity
112 unit is taken care of by 12 obstetricians-gynaecologists and 21 midwives. The hospital has a
113 neonatology unit is taken care of by five paediatricians, two general practitioners, and fourteen
114 nurses.

115 *Participants, sampling and follow-up.*

116 The cases were selected based on the guidelines of the Obstetricians and Gynaecologists of
117 Canada (4), the International Federation of Obstetricians and Gynaecology (5) and the Royal
118 College of Obstetricians and Gynaecologists (6). The minimal sample size was calculated
119 assuming a VBD prevalence rate of 3% (1) and a precision of 5% (14), hence a minimum of
120 48 cases of VBD required. Each case of VBD of newborn weighing 2500 – 3500g was
121 matched for maternal age and parity to four consecutive VCD of newborns weighing 2500 –
122 3500g. We excluded all pregnant women with multiple gestations, footling breech
123 presentation, clinically inadequate maternal pelvis, preterm delivery (less than 37 weeks of
124 gestation), post term pregnancies (\geq 41 weeks of gestation), known cases of foetal demise
125 prior to the onset of labour. Additional exclusion criteria were the presence of a major foetal

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3 126 congenital anomaly (like anencephaly, congenital heart diseases, hydrocephalus), or if there
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5 127 was a contraindication to vaginal delivery such as placenta praevia. In both VBD and VCD
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7 128 groups, we excluded cases of vaginal delivery converted to caesarean delivery. Data was
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9 129 retrieved from case files on important variables in both groups for women and their
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11 130 newborns.
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13 131 *Management of delivery*

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18 132 In this hospital, it is a policy for an experienced obstetrician to be present for every VBD and
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20 133 to augment breech labour only with oxytocin in cases of dynamic dystocia. All deliveries
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22 134 occurred with women lying in the recumbent position with legs in holders. Foetal heart
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24 135 monitoring during labour is done electronically by means of a cardiotocography machine.
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28 136 *Data collection and variables.*

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31 137 We identified the records of all women-newborn couples for term singleton breech deliveries
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33 138 using the delivery registers. Their medical records were then retrieved from the hospital
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35 139 archives for data extraction. The variables studied were:
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- 39 140 ▪ **Maternal demographic data:** maternal age, marital status and profession.
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41 141 ▪ **Obstetric history:** parity and number of antenatal care visits.
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43 142 ▪ **Details of labour:** foetal presentation, foetal heart rhythm, premature rupture of
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45 143 membranes, umbilical cord prolapse, uterine contractions, colour of amniotic fluid,
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47 144 duration of labour, episiotomy, perineal tears, APGAR score at the 5th minute and
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49 145 birth injuries, perinatal deaths.
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51 146 ▪ **Postpartum complications:** postpartum haemorrhage, urinary or faecal incontinence
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53 147 in women, and perinatal mortality for newborns.
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148 **Definition of terms**

149 Brachial plexus injury was defined as any paralysis of the muscles of the shoulder girdle,
150 arm, forearm of the newborn and occurring after dystocia (difficult childbirth). It was
151 diagnosed by the attending obstetrician or midwife at birth and confirmed by a paediatrician
152 during the first physical examination of the newborn within 24 hours of birth. Birth asphyxia
153 was diagnosed based on the Modified Sarnat-Sarnat Score (15) and a five-minute Apgar
154 score ≤ 3 associated with neurological signs such as hypotonia, coma or convulsions (16).
155 The length of labour was the estimated time period from 4 cm cervical dilatation to expulsion
156 of the foetus. For all deliveries, this time interval was monitored and recorded on a
157 partogram. Foetal Distress was defined as the occurrence of foetal tachycardia (foetal heart
158 beats > 160 beats/min) or foetal bradycardia (< 110 beats/min) (17). PPH was defined as an
159 estimated blood loss greater than 500 ml within 24 hours after vaginal delivery (18).

160 ***Data management and statistical analysis***

161 Data was entered in Epi Info 7.1.3.3 software. Comparison of variables between pregnant
162 women who had VBD and VCD was done using the Chi-square test or Fisher exact test
163 where appropriate. Odds ratios (OR) and their corresponding 95% confidence intervals (95%
164 CI) were calculated in order to measure associations. The original alpha-value was set at
165 0.05. In order to reduce the chance of obtaining a type 1 error from the multiple analyses
166 performed on the same dependent variable, Bonferroni adjusted p-values were calculated by
167 dividing the alpha-value by the number of comparisons. Hence, any comparison was
168 statistically significant if it was inferior to the Bonferroni adjusted p-value.

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171 ***Ethical consideration***

172 The study was approved by the Institutional Review Board of the Faculty of Medicine and
173 Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon.

174

175 **Results**

176 ***Demographic and obstetrical characteristics***

177 During the five-year review period, a total of 13, 695 deliveries were recorded. Among these
178 deliveries, 364 breech deliveries occurred, giving an incidence of 26.6 per 1000 deliveries.
179 After strict application of our eligibility criteria, we retained the files of 53 women with
180 singleton term vaginal breech deliveries of babies weighing between 2500 - 3500g (Figure 1).
181 Of the 53 VBD, 12 (22.6%) were unexpected breech births diagnosed during labour and nine
182 (17%) vaginal breech births required forceps delivery. These women were matched to 212
183 women with singleton term VCD of newborns weighing between 2500 - 3500g during the
184 same study period. There were 35 frank breech presentations (66%) and complete breech in
185 18 cases (34%). The maternal ages ranged from 15 to 45 years and the most frequent age
186 group was 20 – 30 years (54.7%). Half had attended at least four antenatal care (ANC) visits,
187 54.7% were unemployed and 45.3% were married. Both VBD and VCD groups showed
188 similarities in maternal age, parity, marital and employment status (table 1).

189 ***Maternal outcomes***

190 Unlike pregnant women who had VCD, those who underwent VBD were more likely to have
191 emission of meconium stained amniotic fluid (OR: 13.45; 95% CI: 4.54-39.84; p <0.001),
192 prolonged labour (OR: 8.05; 95% CI: 3.00-11.47; p <0.001), premature rupture of

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193 membranes (OR: 2.14; 95% CI: 1.02-4.48; $p = 0.04$), and postpartum haemorrhage (OR:
194 3.07; 95% CI: 1.11-8.50; $p = 0.03$). After Bonferroni adjustment (p -value < 0.005), only
195 prolonged labour, meconium stained amniotic fluid and delivery by a midwife were retained
196 as determinants of adverse maternal outcomes of VBD (table 2).

197 *Neonatal outcomes*

198 Compared to babies born of VCD, those delivered through VBD were more likely to have
199 foetal distress (OR: 2.05; 95% CI: 1.14-3.67; $p = 0.0153$), brachial plexus injury (OR: 3.91;
200 95% CI: 2.11-7.26; $p = 0.0262$), and about five-fold as likely to suffer from birth asphyxia
201 (OR: 4.74; 95% CI: 3.09-7.26; $p < 0.001$). Only birth asphyxia was retained as an adverse
202 neonatal outcome after Bonferroni correction ($p < 0.0125$) (table 3).

204 **Discussion**

205 This study aimed at determining the maternal and neonatal outcomes of vaginal breech
206 delivery for singleton term pregnancies in a tertiary mother and child hospital in Yaounde,
207 Cameroon. Despite the application of the aforementioned guidelines (4–6), VBD was found
208 to be significantly associated with prolonged labour (OR: 8.05; 95% CI: 3.00-11.47; p
209 < 0.001), emission of meconium stained amniotic fluid (OR: 13.45; 95% CI: 4.54-39.84; p
210 < 0.001), and birth asphyxia (OR: 10.24; 95% CI: 4.92-21.31; $p < 0.001$). This observation
211 could be the result of the high incidence of dystocia associated with this presentation (19).

212 The findings indicate that the perinatal mortality in VBD was comparable to that of VCD
213 (2% vs 0%; $p = 0.2$). This may be attributed to the fact that the study was carried out in
214 referral hospital with an experienced obstetric team and with means of electronic foetal

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3 215 monitoring (cardiotocography) to timely detect warning signs of non-reassuring foetal status
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5 216 during vaginal breech birth. These results are consistent with the studies reporting no
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7 217 difference in the perinatal mortality following breech delivery in resource-limited settings
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9 218 (20,21). On the other hand, Kemfang et al (22) in a similar study setting in Cameroon
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11 219 reported a significant perinatal mortality ($p < 0.01$) for breech deliveries, which could be due
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13 220 to the absence of well-defined selection criteria for vaginal breech delivery in their series.
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15 221 Their observed perinatal mortality was in cases of macrosomia, nuchal extension, dystocic
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17 222 labour and placental abruption, which were all excluded in the current cohort.
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22 223 Neonates delivered through breech birth were more likely to have birth asphyxia than those
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24 224 who had a vaginal cephalic birth (47% vs. 8%; $p < 0.001$), corroborating previous studies
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26 225 from both high-income (3,23) and low-income settings (20,21,24). This could be related to
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28 226 the fact that breech fetuses face an increased risk of hypoxic-anoxic events from head
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30 227 entrapment, rapid decompression of the head, and other birth trauma (7).
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34 228 The main limitation of this study was that being a retrospective study, data collection was
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36 229 subject to the potential risk of reviewing incorrectly completed records. Furthermore, less
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38 230 than four ANC visits were attended in 68% of VBD compared to 43% of VCD studied ($p =$
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40 231 0.002). ANC attendance was not a matching variable between the VBD and VCD groups.
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42 232 Hence, the VBD cases were a higher risk group from the onset of the study and 22.6% of
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44 233 VBD were unrecognised before the onset of labour. Also, the study was conducted in an
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46 234 urban centre with standards of a tertiary level of care, which implies cautious generalization
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48 235 of our results to health facilities not having the same level of care. Nevertheless, based on
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50 236 careful selection criteria of singleton term VBD and the statistical analysis used to eliminate
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52 237 bias, we reviewed a five-year period to assess the outcomes of VBD in a low-income country
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54 238 where caesarean delivery cannot be generalized as the route of delivery for all breech
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239 presentations because of its financial cost and the prevalent inadequate surgical infrastructure
240 in most health facilities. The findings are a significant contribution to the on-going debate on
241 the safety of vaginal breech delivery in sub-Saharan Africa.

242

243 **Conclusion**

244 The findings suggest that even when breech delivery guidelines are applied, VBD of
245 singleton term pregnancies is still associated with a high incidence of maternal and perinatal
246 morbidity. This finding does not discount the role of VBD in resource-poor settings, but
247 emphasises the need for rigorous monitoring of labour, timely decision and adequate
248 anticipation for neonatal resuscitation in order to reduce these complications. Also, the
249 practise of external cephalic version should be taught and promoted in this resource-limited
250 setting as a means to convert breech to cephalic presentations and reduce the perinatal and
251 maternal morbidities associated with VBD. Refresher courses for the management of breech
252 birth should be organised for health personnel in order to minimize risk of brachial plexus
253 injury. Based on the limitations of the study, there is a need to carry out large multicentre
254 clinical trials in our resource-limited settings.

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256 the Yaounde Gynaeco-Obstetric and Paediatric Hospital for granting them permission to
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258 **Authors' contributions:** JSD, PF and EM: Study conception and design, acquisition of data,
259 data analysis and interpretation, manuscript writing and critical revisions. FM: Study
260 conception and design, acquisition of data, data analysis and interpretation and manuscript

261 writing. JNT, MNT, RT and VA: Acquisition of data, data analysis and interpretation,
262 manuscript writing and revisions. All authors read and approved the final manuscript.

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265 **Competing interests:** We have read and understood BMJ policy on declaration of interests
266 and declare that we have no competing interests.

267 **Ethical Approval:** The study was approved by the Institutional Review Board of the Faculty
268 of Medicine and Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon.

269 **Data sharing statement:** No additional data are available.

271 **Figure and Table Legend**

272 Figure 1: Flow chart depicting selection of vaginal breech and cephalic delivery cases.

273 Table 1: Socio-demographic characteristics and obstetric history of mothers

274 Table 2: Maternal outcomes of vaginal breech delivery

275 Table 3: Analysis of neonatal outcomes associated with vaginal breech delivery

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Table 1: Socio-demographic characteristics and obstetric history of mothers

Groups	Number (%)	Vaginal breech delivery (n=53)	Vaginal cephalic delivery (n=212)	p-value
Maternal age groups (years)				
< 20	31 (11.7%)	6	25	0.3068
20 - 30	145(54.7%)	25	120	
30 - 40	85(32.1%)	20	65	
>40	4 (1.5%)	2	2	
Occupation*				
Unemployed	145 (54.7%)	31	114	0.3323
Employed	72 (27.2%)	10	62	
Self-employed	47 (18.1%)	11	36	
Marital status*				
Married	120 (45.3%)	28	96	0.4414
Single	117 (44.2%)	18	94	
Cohabitation	27 (10.2%)	6	22	
Parity				
Nulliparous (parity = 0)	104 (39.3%)	18	86	0.6199
Primiparous (parity = 1)	60 (22.6%)	12	48	
Multiparous (parity > 1)	101 (38.1%)	23	78	
Number of antenatal care visits ^β				
≥ 4	135 (51%)	17	115	0.002
< 4	127 (48%)	36	91	

*1 missing data; ^β 3 missing data

368 **Table 2:** Maternal outcomes of vaginal breech delivery

Variables	Vaginal breech delivery (n=53)	Vaginal cephalic delivery (n=212)	Odds ratio	95% confidence interval	p-value
Premature rupture of membranes					
Yes	13 (24.5%)	28 (13%)	2.14	1.02-4.48	0.0448
No	40 (75.5%)	184 (87%)			
Meconium stained amniotic fluid					
Yes	13 (24.5%)	5 (2.4%)	13.45	4.54-39.84	< 0.001
No	40 (75.5%)	207 (97.6%)			
Umbilical cord prolapse					
Yes	2 (4%)	1 (0.5%)	8.27	0.74-93.05	0.087
No	51 (96%)	211 (99.5%)			
Prolonged labour (> 12 hours)					
Yes	25 (47%)	28 (13%)	8.05	3.00-11.47	< 0.001
No	28 (53%)	184 (87%)			
Course of labour					
Augmented with oxytocin	2 (4%)	15 (7.1%)	0.52	0.11-2.33	0.3882
Spontaneous	51 (96%)	197 (92.9%)			
Episiotomies					
Yes	3 (5.7%)	22 (10.4%)	0.52	0.15-1.80	0.301
No	50 (94.3%)	190 (89.6%)			
Perineal tears					
Yes	17 (32%)	64 (30%)	1.09	0.57-2.09	0.7897
No	36 (68%)	148 (70%)			
Uterine atony					
Yes	1 (2%)	5 (2.4%)	0.79	0.09-6.96	0.8368
No	52 (98%)	207 (97.6%)			
Postpartum haemorrhage					
Yes	7 (13.2%)	10 (4.7%)	3.07	1.11-8.50	0.0305
No	46 (86.8%)	202 (95.3%)			

369 Bonferroni corrected p-value < 0.00556.

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Table 3: Analysis of neonatal outcomes associated with vaginal breech delivery

Neonatal outcomes	Vaginal breech delivery (n=53)	Vaginal cephalic delivery (n=212)	Odds Ratio	95% confidence interval	p-value
Foetal distress					
Yes	9 (17%)	15 (7%)	2.69	1.11-6.53	0.0293
No	44 (83%)	197 (93%)			
Neonatal asphyxia					
Yes	25 (47.2%)	17 (8.0%)	10.24	4.92-21.31	< 0.001
No	28 (52.8%)	195 (92%)			
Brachial plexus injury					
Yes	3 (5.7%)	01(0.5%)	12.66	1.28-124.28	0.0262
No	50 (94.3%)	211 (99.5%)			
Perinatal deaths					
Yes	1 (2%)	00	12.14	0.49-302.36	0.128
No	52 (98%)	212 (100%)			

Bonferroni corrected p-value < 0.0125.

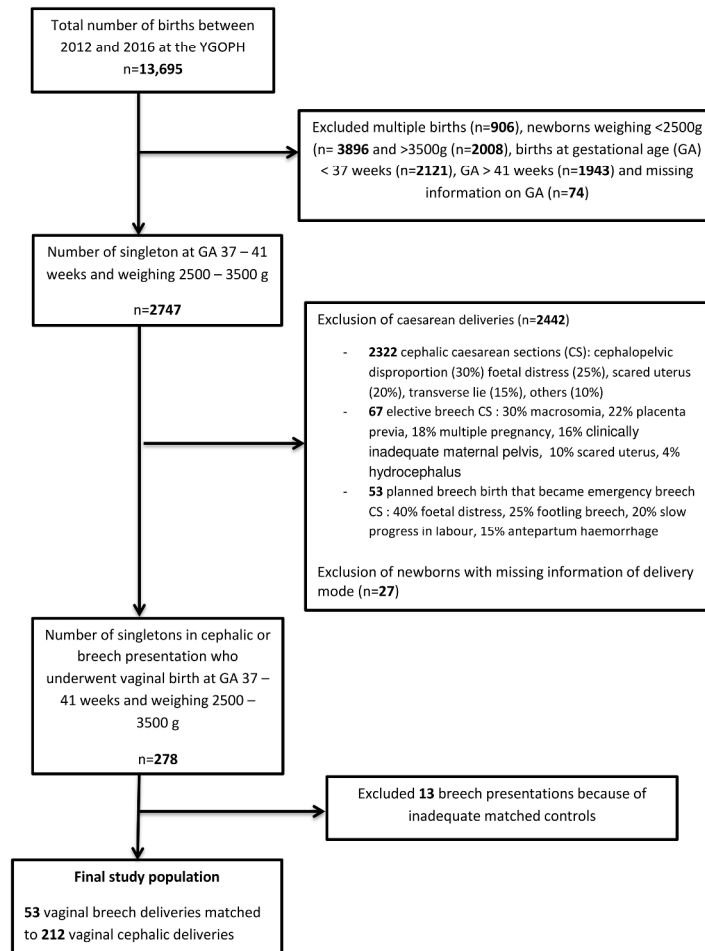


Figure 1: Flow chart depicting selection of vaginal breech and cephalic delivery cases.

Figure 1: Flow chart depicting selection of vaginal breech and cephalic delivery cases.

148x210mm (600 x 600 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	Page 1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Pages 3 and 4
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Pages 5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Page 5
		(b) For matched studies, give matching criteria and number of exposed and unexposed	Page 5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 6
Bias	9	Describe any efforts to address potential sources of bias	Page 6
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Page 7
		(b) Describe any methods used to examine subgroups and interactions	-
		(c) Explain how missing data were addressed	Page 7
		(d) If applicable, explain how loss to follow-up was addressed	Page 7
		(e) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 8
		(b) Give reasons for non-participation at each stage	Figure 1
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 8
		(b) Indicate number of participants with missing data for each variable of interest	Page 8
		(c) Summarise follow-up time (eg, average and total amount)	Page 8
Outcome data	15*	Report numbers of outcome events or summary measures over time	Pages 8 and 9
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Pages 8 and 9
		(b) Report category boundaries when continuous variables were categorized	-
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 9
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pages 9 and 10
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Not applicable

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Secondary Subject Heading:	Reproductive medicine
Keywords:	breech, vaginal delivery, cephalic presentation, singleton term pregnancies, outcome, Cameroon

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Title:

Maternal and neonatal outcomes of vaginal breech delivery for singleton term pregnancies in a carefully selected Cameroonian population: a cohort study.

Authors:

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Abstract

Background and objectives: Vaginal breech delivery (VBD) is known to be associated with more perinatal and maternal complications. Very few studies on the subject have been carried out in poor resource settings. The aim of this study was to determine maternal and neonatal outcomes in carefully selected cases of VBD for singleton term pregnancies in a tertiary centre in Cameroon.

Design: A retrospective cohort study

Setting: A tertiary hospital in Yaounde, Cameroon

Participants: Cases of VBD of newborns weighing 2500 – 3500g were matched in a ratio of 1:4 to consecutive vaginal cephalic deliveries (VCD) of newborns weighing 2500 – 3500g over a five-year period. Both groups were matched for maternal age and parity. We excluded cases of multiple gestations, footling breech, clinically inadequate maternal pelvis, preterm delivery, post term pregnancies, foetal demise prior to the onset of labour, placenta praevia and foetal anomaly incompatible with vaginal delivery.

Outcome measures: Neonatal and maternal adverse outcomes of VBD observed till six weeks after delivery analysed using Bonferroni correction.

Results: Fifty-three (53) VBD were matched against 212 VCD. Unlike women who had VCD, those who underwent VBD were more likely to have prolonged labour (OR: 8.05; 95% CI: 3.00-11.47; $p < 0.001$), and their newborns were more likely to suffer from birth asphyxia (OR: 10.24; 95% CI: 4.92-21.31; $p < 0.001$).

Conclusion: The study infers a strong association between VBD of singleton term pregnancies and maternofoetal morbidity when specific protocols are applied. This however, failed to translate into higher differences in perinatal mortality. This finding does not discount the role of VBD in low-income countries, but we emphasize the need for specific precautions like close monitoring of labour and adequate anticipation for neonatal resuscitation in order to reduce these complications.

Keywords: breech, vaginal delivery, cephalic presentation, singleton term pregnancies, outcome, Cameroon.

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Strengths of the study:

- The use of guidelines to select cases of vaginal breech delivery in order to decrease the risk of selection bias in the findings obtained.
- Bias was further reduced by calculating Bonferroni adjusted p-values

Limitations of the study:

- The study had a retrospective nature of data collection, which was subject to a potential risk of incorrectly completed records.
- The study was carried out in a single centre with standards of a tertiary level of care, which implies cautious generalization of results to health facilities not having the same level of care.

Introduction:

Breech presentations represent 3 – 4% of all foetal presentations at term (1). Vaginal breech deliveries (VBD) are associated with a ten-fold increase in perinatal mortality when compared to vaginal cephalic deliveries (VCD) (2).

The safest mode of delivery in case of breech presentation has long been a debate in obstetrics (3). It is recommended to carry out elective caesarean section rather than vaginal delivery for singleton term breech pregnancies when there is foetal distress, macrosomia, footling breech presentation, clinically inadequate maternal pelvis, growth-restricted baby, placenta praevia or foetal anomaly incompatible with vaginal delivery, or if an experienced clinician is absent or the clinician lacks adequate expertise for VBD (4–6). Evidence abounds that unlike VBD for singleton term pregnancies, elective caesarean section reduces perinatal mortality and morbidity, as well as maternal morbidity (urinary incontinence and postpartum perineal pains) in developed countries (7). However, in resource-limited countries, the outcomes of both VBD and elective caesarean breech delivery appear comparable (7), possibly due to the prevailing expertise of birth attendants in VBD in these resource-

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3 78 challenged settings (3). Furthermore, it has been shown that as much as 39 caesarean sections
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5 79 are required to prevent one neonatal death or adverse neonatal outcome in low-income
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7 80 countries compared to seven caesarean sections needed in high-income settings (3). Hence, a
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9 81 health policy generalizing the indication of caesarean section to all breech presentations in
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11 82 low-income countries would require significant additional investments in their health care
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13 83 systems. Also, the presence of a scarred uterus puts subsequent pregnancies at increased risk
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15 84 of complications such as placenta praevia, placenta accreta and placenta abruption, uterine
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17 85 rupture, repeat caesarean section and repeat breech presentation (6,8–11). Likewise, elective
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19 86 caesarean section for breech presentation cannot be performed in all resource-limited settings
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21 87 due to its financial cost and the prevalent inadequate surgical infrastructure in most health
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23 88 facilities (7).
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29 89 As such, external cephalic version for singleton term pregnancies has been recommended as a
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31 90 safe and cost-effective means to revert breech to cephalic presentation and avert the resort to
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33 91 either VBD or caesarean sections (12). However, external cephalic version is not routinely
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35 92 performed in clinical practice because many health personnel lack its mastery or unduly
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37 93 perceive it to be associated with adverse perinatal outcomes (13). Thus, vaginal delivery is
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39 94 still the main route of delivery in resource-limited environments. Data on vaginal breech
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41 95 delivery for singleton term pregnancies in sub-Saharan Africa is scarce, thus, explaining the
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43 96 lack of consensus on the management of this foetal presentation in the continent. The aim of
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45 97 this study was to elucidate the maternal and neonatal outcomes of vaginal delivery of
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47 98 singleton term foetus in breech presentation following strict selection criteria in a tertiary
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102 **Materials and Methods**

103 *Study design and setting*

104 In this cohort study, we reviewed case notes of all pregnant women at term who had a VBD
105 and pregnant women at term with VCD at the maternity of the Yaounde Gynaeco-Obstetric
106 and Pediatric Hospital (YGOPH) between 1st January 2012 to 31st December 2016. The
107 YGOPH is a tertiary hospital located in Yaoundé, the political capital of Cameroon. This
108 health facility serves as a major referral centre for mother and child care in Yaounde and its
109 environs. Its annual number of child births varies between 2000 to 2500 deliveries. The
110 YGOPH is equipped with modern equipment and personnel to provide comprehensive
111 Emergency Obstetric and Neonatal Care (EmONC) services. The maternity unit is managed
112 by 12 obstetricians-gynaecologists and 21 midwives. The hospital has a neonatology unit
113 whose staff is comprised of five paediatricians, two general practitioners, and fourteen
114 nurses.

115 *Participants, sampling and follow-up.*

116 The cases were selected based on the guidelines of the Obstetricians and Gynaecologists of
117 Canada (4), the International Federation of Obstetricians and Gynaecology (5) and the Royal
118 College of Obstetricians and Gynaecologists (6). Using a ratio of control to cases of 4 , a
119 95% confidence interval, minimum power to detect a difference of 80%, and assuming a
120 minimum odd ratio of 2 for differences to be detected, the formula for difference in
121 proportions (14) was used to calculate the minimum sample size. Therefore the number of
122 VBD required for the study was 41 and the number of controls (VCD) was 164. Each case of
123 VBD of newborn weighing 2500 – 3500g was matched for maternal age and parity to four
124 consecutive VCD of newborns weighing 2500 – 3500g. We excluded all pregnant women
125 with multiple gestations, footling breech presentation, clinically inadequate maternal pelvis,

preterm delivery (less than 37 weeks of gestation), post term pregnancies (≥ 41 weeks of gestation), known cases of foetal demise prior to the onset of labour. Additional exclusion criteria were the presence of a major foetal congenital anomaly (like anencephaly, congenital heart diseases, hydrocephalus), or if there was a contraindication to vaginal delivery such as placenta praevia. In both VBD and VCD groups, we excluded cases of vaginal delivery converted to caesarean delivery. Data was retrieved from case files on important variables in both groups for women and their newborns.

Management of delivery

In this hospital, it is a policy for an experienced obstetrician to be present for every VBD and to augment breech labour only with oxytocin in cases of dynamic dystocia. All deliveries occurred with women lying in the recumbent position with legs in holders. Foetal heart monitoring during labour is done electronically by means of a cardiotocography machine.

Data collection and variables.

We identified the records of all women-newborn dyads for term singleton breech deliveries using the delivery registers. Their medical records were then retrieved from the hospital archives for data extraction. The variables studied were:

- **Maternal demographic data:** maternal age, marital status and profession.
- **Obstetric history:** parity and number of antenatal care visits.
- **Details of labour:** foetal presentation, foetal heart rhythm, premature rupture of membranes, umbilical cord prolapse, uterine contractions, colour of amniotic fluid, duration of labour, episiotomy, perineal tears, APGAR score at the 5th minute and birth injuries, perinatal deaths.

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148 ▪ **Postpartum complications:** postpartum haemorrhage, urinary or faecal incontinence
149 in women, and perinatal mortality for newborns.

150 **Definition of terms**

151 Brachial plexus injury was defined as any paralysis of the muscles of the shoulder girdle,
152 arm, forearm of the newborn and occurring after dystocia (difficult childbirth). It was
153 diagnosed by the attending obstetrician or midwife at birth and confirmed by a paediatrician
154 during the first physical examination of the newborn within 24 hours of birth. Birth asphyxia
155 was diagnosed based on the Modified Sarnat-Sarnat Score (15) and a five-minute Apgar
156 score ≤ 3 associated with neurological signs such as hypotonia, coma or convulsions (16).
157 The duration of labour was the estimated time period from 4 cm cervical dilatation to
158 expulsion of the foetus. For all deliveries, this time interval was monitored and recorded on a
159 partogram. Foetal Distress was defined as the occurrence of foetal tachycardia (foetal heart
160 beats > 160 beats/min) or foetal bradycardia (< 110 beats/min) (17). PPH was defined as an
161 estimated blood loss greater than 500 ml within 24 hours after vaginal delivery (18).

162 ***Data management and statistical analysis***

163 Data was entered in Epi Info 7.1.3.3 software. Comparison of variables between pregnant
164 women who had VBD and VCD was done using the Chi-square test or Fisher exact test
165 where appropriate. Odds ratios (OR) and their corresponding 95% confidence intervals (95%
166 CI) were calculated in order to measure associations. The original alpha-value was set at
167 0.05. In order to reduce the chance of obtaining a type 1 error from the multiple analyses
168 performed on the same dependent variable, Bonferroni adjusted p-values were calculated by
169 dividing the alpha-value by the number of comparisons. Hence, any comparison was
170 statistically significant if it was inferior to the Bonferroni adjusted p-value.

171 ***Ethical consideration***

172 The study was approved by the Institutional Review Board of the Faculty of Medicine and
173 Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon.

174

175 **Results**

176 ***Demographic and obstetrical characteristics***

177 During the five-year review period, a total of 13, 695 deliveries were recorded. Among these
178 deliveries, 364 breech deliveries occurred, giving an incidence of 26.6 per 1000 deliveries.
179 After strict application of our eligibility criteria, we retained the files of 53 women with
180 singleton term vaginal breech deliveries of babies weighing between 2500 - 3500g (Figure 1).
181 Of the 53 VBD, 12 (22.6%) were unexpected breech births diagnosed during labour and nine
182 (17%) vaginal breech births required forceps delivery mainly as a result of delayed expulsion
183 of the after coming head. These women were matched to 212 women with singleton term
184 VCD of newborns weighing between 2500 - 3500g during the same study period. There were
185 35 frank breech presentations (66%) and complete breech in 18 cases (34%). The maternal
186 ages ranged from 15 to 45 years and the most frequent age group was 20 – 30 years (54.7%).
187 Half had attended at least four antenatal care (ANC) visits, 54.7% were unemployed and
188 45.3% were married. Both VBD and VCD groups showed similarities in maternal age, parity,
189 marital and employment status (table 1).

190 ***Maternal outcomes***

191 Unlike paturients who had VCD, those who underwent VBD were more likely to have
192 prolonged labour (OR: 8.05; 95% CI: 3.00-11.47; p <0.001), premature rupture of

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193 membranes (OR: 2.14; 95% CI: 1.02-4.48; $p = 0.04$), and postpartum haemorrhage (OR:
194 3.07; 95% CI: 1.11-8.50; $p = 0.03$). After Bonferroni adjustment (p -value < 0.006), only
195 prolonged labour, meconium stained amniotic fluid and delivery by a midwife were retained
196 as determinants of adverse maternal outcomes of VBD (table 2).

197 *Neonatal outcomes*

198 Compared to babies born of VCD, counterparts (VBD group) were more likely to have foetal
199 distress (OR: 2.05; 95% CI: 1.14-3.67; $p = 0.0153$), brachial plexus injury (OR: 3.91; 95%
200 CI: 2.11-7.26; $p = 0.0262$), and about five-fold as likely to suffer from birth asphyxia (OR:
201 4.74; 95% CI: 3.09-7.26; $p < 0.001$). Only birth asphyxia was retained as an adverse neonatal
202 outcome after Bonferroni correction ($p < 0.0125$) (table 3).

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204 **Discussion**

205 This study aimed at determining the maternal and neonatal outcomes of vaginal breech
206 delivery for singleton term pregnancies in a tertiary mother and child hospital in Yaounde,
207 Cameroon. Despite the application of the aforementioned guidelines (4–6), VBD was found
208 to be significantly associated with prolonged labour (OR: 8.05; 95% CI: 3.00-11.47; p
209 < 0.001), and birth asphyxia (OR: 10.24; 95% CI: 4.92-21.31; $p < 0.001$). This observation
210 could be the result of the high incidence of dystocia associated with this presentation (19).

211 The findings indicate that the perinatal mortality in VBD was comparable to that of VCD
212 (2% vs 0%; $p = 0.2$). This may be attributed to the fact that the study was carried out in
213 referral hospital with an experienced obstetric team and with means of electronic foetal
214 monitoring (cardiotocography) to timely detect warning signs of non-reassuring foetal status

215 during vaginal breech birth. These results are consistent with the studies reporting no
216 difference in the perinatal mortality following breech delivery in resource-limited settings
217 (20,21). On the other hand, Kemfang et al (22) in a similar study setting in Cameroon
218 reported a significant perinatal mortality ($p < 0.01$) for breech deliveries, which could be due
219 to the absence of well-defined selection criteria for vaginal breech delivery in their series.
220 Their observed perinatal mortality was in cases of macrosomia, nuchal extension, dystocic
221 labour and placental abruption, which were all excluded in the current cohort.

222 Neonates delivered through breech birth were more likely to have birth asphyxia than those
223 who had a vaginal cephalic birth (47% vs. 8%; $p < 0.001$), corroborating previous studies
224 from both high-income (3,23) and low-income settings (20,21,24). This could be related to
225 the fact that breech foetuses are predisposed to an increased risk of hypoxic-anoxic events
226 from head entrapment, rapid decompression of the head, and other birth trauma (7).

227 The main limitation of this study was that being a retrospective study, data collection was
228 subject to the potential risk of reviewing incorrectly completed records. Furthermore, less
229 than four ANC visits were attended in 68% of VBD compared to 43% of VCD studied ($p =$
230 0.002). ANC attendance was not a matching variable between the VBD and VCD groups.
231 Hence, the VBD cases were a higher risk group from the onset of the study and 22.6% of
232 VBD were unrecognised before the onset of labour. Also, the study was conducted in an
233 urban centre with standards of a tertiary level of care, which implies cautious generalization
234 of our results to health facilities not having the same level of care. Nevertheless, based on
235 careful selection criteria of singleton term VBD and the statistical analysis used to eliminate
236 bias, we reviewed a five-year period to assess the outcomes of VBD in a low-income country
237 where caesarean delivery cannot be generalized as the mode of delivery for all breech
238 presentations because of its financial cost and the prevalent inadequate surgical infrastructure

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239 in most health facilities. The findings are a significant contribution to the on-going debate on
240 the safety of vaginal breech delivery in sub-Saharan Africa.

241
242 **Conclusion**

243 The findings suggest that even when breech delivery guidelines are applied, VBD of
244 singleton term pregnancies is still associated with a high incidence of maternal and perinatal
245 morbidity. This finding does not discount the role of VBD in resource-poor settings, but
246 emphasises the need for rigorous monitoring of labour, timely decision and adequate
247 anticipation for neonatal resuscitation in order to reduce these complications. Also, the
248 practise of external cephalic version should be taught and promoted in this resource-limited
249 setting as a means to convert breech to cephalic presentations and reduce the perinatal and
250 maternal morbidities associated with VBD. Refresher courses for the management of breech
251 birth should be organised for health personnel in order to minimize risk of brachial plexus
252 injury. Based on the limitations of the study, there is a need to carry out large multicentre
253 clinical trials in our resource-limited settings.

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255 the Yaounde Gynaeco-Obstetric and Paediatric Hospital for granting them permission to
256 conduct this study.

257 **Authors' contributions:** JSD, PF and EM: Study conception and design, acquisition of data,
258 data analysis and interpretation, manuscript writing and critical revisions. FM: Study
259 conception and design, acquisition of data, data analysis and interpretation and manuscript
260 writing. JNT, MNT, RT and VA: Acquisition of data, data analysis and interpretation,
261 manuscript writing and revisions. All authors read and approved the final manuscript.

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Competing interests: We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests.

Ethical Approval: The study was approved by the Institutional Review Board of the Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon.

Data sharing statement: No additional data are available.

Figure and Table Legend

Figure 1: Flow chart depicting selection of vaginal breech and cephalic delivery cases.

Table 1: Socio-demographic characteristics and obstetric history of parturients

Table 2: Maternal outcomes of vaginal breech delivery

Table 3: Analysis of neonatal outcomes associated with vaginal breech delivery

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Table 1: Socio-demographic characteristics and obstetric history of mothers

Groups	Number (%)	Vaginal breech delivery (n=53)	Vaginal cephalic delivery (n=212)	p-value
Maternal age groups (years)				
< 20	31 (11.7%)	6	25	0.3068
20 - 30	145(54.7%)	25	120	
30 - 40	85(32.1%)	20	65	
>40	4 (1.5%)	2	2	
Occupation*				
Unemployed	145 (54.7%)	31	114	0.3323
Employed	72 (27.2%)	10	62	
Self-employed	47 (18.1%)	11	36	
Marital status*				
Married	120 (45.3%)	28	96	0.4414
Single	117 (44.2%)	18	94	
Cohabitation	27 (10.2%)	6	22	
Parity				
Nulliparous (parity = 0)	104 (39.3%)	18	86	0.6199
Primiparous (parity = 1)	60 (22.6%)	12	48	
Multiparous (parity > 1)	101 (38.1%)	23	78	
Number of antenatal care visits ^β				
≥ 4	135 (51%)	17	115	0.002
< 4	127 (48%)	36	91	

*1 missing data; ^β 3 missing data

370 **Table 2:** Maternal outcomes of vaginal breech delivery

Variables	Vaginal breech delivery (n=53)	Vaginal cephalic delivery (n=212)	Odds ratio	95% confidence interval	p-value
Premature rupture of membranes					
Yes	13 (24.5%)	28 (13%)	2.14	1.02-4.48	0.0448
No	40 (75.5%)	184 (87%)			
Umbilical cord prolapse					
Yes	2 (4%)	1 (0.5%)	8.27	0.74-93.05	0.087
No	51 (96%)	211 (99.5%)			
Prolonged labour (> 12 hours)					
Yes	25 (47%)	28 (13%)	8.05	3.00-11.47	< 0.001
No	28 (53%)	184 (87%)			
Course of labour					
Augmented with oxytocin	2 (4%)	15 (7.1%)	0.52	0.11-2.33	0.3882
Spontaneous	51 (96%)	197 (92.9%)			
Episiotomies					
Yes	3 (5.7%)	22 (10.4%)	0.52	0.15-1.80	0.301
No	50 (94.3%)	190 (89.6%)			
Perineal tears					
Yes	17 (32%)	64 (30%)	1.09	0.57-2.09	0.7897
No	36 (68%)	148 (70%)			
Uterine atony					
Yes	1 (2%)	5 (2.4%)	0.79	0.09-6.96	0.8368
No	52 (98%)	207 (97.6%)			
Postpartum haemorrhage					
Yes	7 (13.2%)	10 (4.7%)	3.07	1.11-8.50	0.0305
No	46 (86.8%)	202 (95.3%)			

371 Bonferroni corrected p-value < 0.00625.

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Table 3: Analysis of neonatal outcomes associated with vaginal breech delivery

Neonatal outcomes	Vaginal breech delivery (n=53)	Vaginal cephalic delivery (n=212)	Odds Ratio	95% confidence interval	p-value
Foetal distress					
Yes	9 (17%)	15 (7%)	2.69	1.11-6.53	0.0293
No	44 (83%)	197 (93%)			
Neonatal asphyxia					
Yes	25 (47.2%)	17 (8.0%)	10.24	4.92-21.31	< 0.001
No	28 (52.8%)	195 (92%)			
Brachial plexus injury					
Yes	3 (5.7%)	01(0.5%)	12.66	1.28-124.28	0.0262
No	50 (94.3%)	211 (99.5%)			
Perinatal deaths					
Yes	1 (2%)	00	12.14	0.49-302.36	0.128
No	52 (98%)	212 (100%)			

Bonferroni corrected p-value < 0.0125.

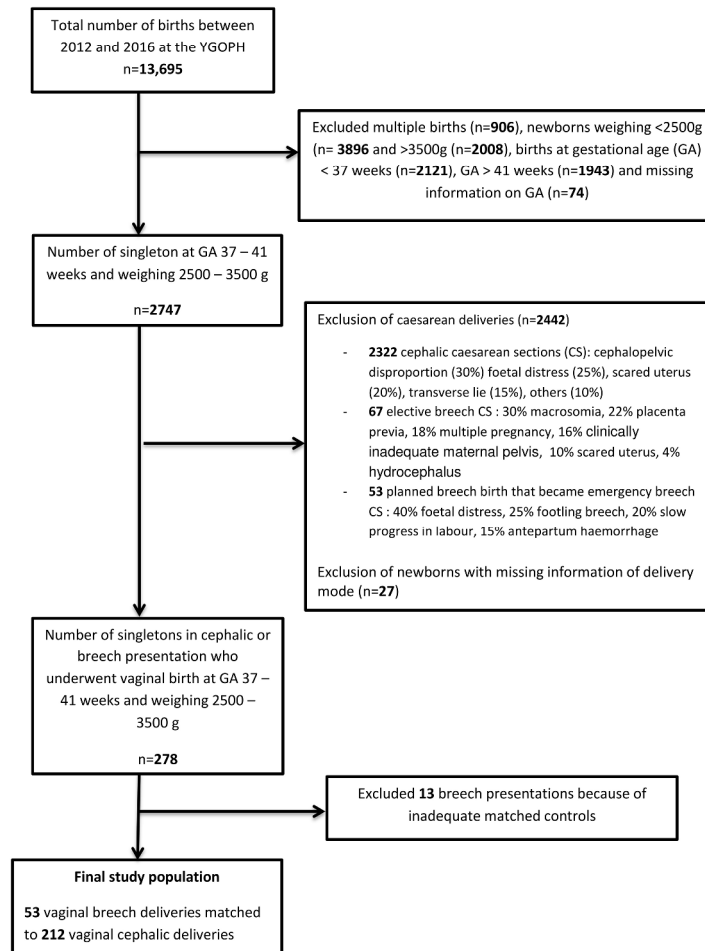


Figure 1: Flow chart depicting selection of vaginal breech and cephalic delivery cases.

Figure 1: Flow chart depicting selection of vaginal breech and cephalic delivery cases.

148x210mm (600 x 600 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	Page 1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Pages 3 and 4
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Pages 5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Page 5
		(b) For matched studies, give matching criteria and number of exposed and unexposed	Page 5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 6
Bias	9	Describe any efforts to address potential sources of bias	Page 6
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Page 7
		(b) Describe any methods used to examine subgroups and interactions	-
		(c) Explain how missing data were addressed	Page 7
		(d) If applicable, explain how loss to follow-up was addressed	Page 7
		(e) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 8
		(b) Give reasons for non-participation at each stage	Figure 1
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 8
		(b) Indicate number of participants with missing data for each variable of interest	Page 8
		(c) Summarise follow-up time (eg, average and total amount)	Page 8
Outcome data	15*	Report numbers of outcome events or summary measures over time	Pages 8 and 9
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Pages 8 and 9
		(b) Report category boundaries when continuous variables were categorized	-
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 9
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pages 9 and 10
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Not applicable

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.